# Fifth Training School on Nuclear and Particle Physics Experiments Using Accelerator Beams

# I. 7. Fifth Training School on Nuclear and Particle Physics Experiments Using Accelerator Beams

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Under the support program of KEK (High Energy Accelerator Research Organization)[1)], the fifth training school was held on nuclear and particle physics experiments using accelerator beams[2)] at Tohoku University in February 2017. The purpose of this school was to foster human resources to support Japanese accelerator sciences, which are preeminent in the world. The target was to let undergraduates in Japan consider accelerator sciences as a career path, by experiencing accelerator experiments and by deepening the understanding of sciences such as nuclear and particle physics, beam physics, and accelerator physics. Ten undergraduate students from eight universities (Fukuoka University, Kitasato University, Saitama University, Shizuoka University of Science and Technology, Tokyo University of Science, University of Toyama, Ochanomizu University, and Rikkyo University) participated in the school. The implementation period lasted six days. The first part and the last part of the school were organized at CYRIC and ELPH (Research Center for Electron Photon Science), respectively.

The experimental theme in CYRIC was “Experiments in a low-velocity electrostatic beam line” and included four practice themes: (1) Production of radioactive francium isotopes through a nuclear fusion evaporation reaction, with a gold target and oxygen beam supplied from 930-AVF cyclotron. (2) Transportation of an ion beam produced with a surface ionizer. (3) Alpha-ray spectroscopy of checking source $^{241}$Am with silicon semiconductor detector. (4) Simulation evaluation of the nuclear fusion evaporation reaction with PACE4 fusion-evaporation code. These practice works were mainly performed using a francium-dedicated experimental apparatuses group[3)], which are

developed by the Fr EDM collaboration at CYRIC. The students were split into three teams, and rotated each theme. Each theme had typically one academic staff and one teaching assistant.

In ELPH, the students performed two experimental themes: “Beam of an electron accelerator”; and “Measurement of the momentum and time of flight of positrons”, with the electron synchrotron accelerator.

According to the results of a questionnaire handed out after the school ended, the practical experiments were received well by the students, and motivated them to consider the career path. Some of the students, especially science-conscious ones, said that they would participate in the school even if there was no financial support for the travel costs (although the organizer subsidized a large part of the travel costs required for participation). These opinions show the ability of the practical experiments to amuse while treating the real accelerators.

The results of this and past schools are beginning to show a fostering of human resources to support Japanese accelerator sciences[4)]. Some of the students participating in earlier schools entered the doctoral course. Most of the participating students hope to continue at the school. In the future, this school, or the same workshop, will continue to be required for supporting the accelerator sciences.

**References**


1) KEK Support Program, https://www.kek.jp/en/ForResearcher/SupportProgram/
2) Official website of the 5th training school on nuclear and particle physics experiments using accelerator beams, http://inst.cyric.tohoku.ac.jp/~sakemi/cyric2016.html
3) Kawamura H, Ando S, Aoki T, et al., *Review of Scientific Instruments* **87** (2016) 02B921.
4) Kawamura H, Inoue T, *Daigaku no Butsuri Kyouiku* **23** (2017) 167.